

AOC	Media	Quantity of Discrete Phase I Samples	Additional Sample Number Basis			Proposed Quantity of Additional Samples
			Human Health	Ecological	Best Professional Judgment	
AOC 1	Soil: Surface & Subsurface	41	14	None	Not Applicable	14
	Sediment	2	Not Applicable	Not Applicable	None	None
	Groundwater	20	7	Not Applicable	Not Applicable	7
AOC 2	Soil: Surface & Subsurface	Composite Samples	Not Applicable	Not Applicable	4	4
AOC 3	Soil: Surface & Subsurface	7	1	14	None	None
	Sediment	44	None	None	6	6
	Surface Water	7	16	5	Not Applicable	16
AOC 4	Soil: Surface & Subsurface	Composite Samples	Not Applicable	Not Applicable	5	5
AOC 5	Sediment	3	Not Applicable	Not Applicable	7	7
AOC 6	Soil: Surface & Subsurface	3	Not Applicable	Not Applicable	None	None
AOC 7	Soil: Surface & Subsurface	2	Not Applicable	Not Applicable	None	None

Report Number	Area Of Concern	Media	Benchmark	Delta Method
1	AOC-1	Surface Soil	Human Health	1
2	AOC-1	Surface Soil	Human Health	2
3	AOC-1	Surface Soil	Ecological	1
4	AOC-1	Surface Soil	Ecological	2
5	AOC-1	Subsurface Soil	Human Health	1
6	AOC-1	Subsurface Soil	Human Health	2
7	AOC-1	Subsurface Soil	Ecological	1
8	AOC-1	Subsurface Soil	Ecological	2
9	AOC-1	Groundwater	Human Health	1
10	AOC-1	Groundwater	Human Health	2
11	AOC-3	Surface Soil	Human Health	1
12	AOC-3	Surface Soil	Human Health	2
13	AOC-3	Surface Soil	Ecological	1
14	AOC-3	Surface Soil	Ecological	2
15	AOC-3	Subsurface Soil	Human Health	1
16	AOC-3	Subsurface Soil	Human Health	2
17	AOC-3	Subsurface Soil	Ecological	1
18	AOC-3	Subsurface Soil	Ecological	2
19	AOC-3	Surface Water	Human Health	1
20	AOC-3	Surface Water	Human Health	2
21	AOC-3	Surface Water	Ecological	1
22	AOC-3	Surface Water	Ecological	2
23	AOC-3	Sediment	Human Health	1
24	AOC-3	Sediment	Human Health	2
25	AOC-3	Sediment	Ecological	1
26	AOC-3	Sediment	Ecological	2

Table D-1  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for  
Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)					Sample Size Method 1	Sample Size Method 2	Statistical Power? <sup>3</sup>	Proposed quantity of additional samples to collect <sup>4</sup>	Notes
		Bench- mark	Max	Mean	95th UCL of Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark <sup>1</sup>	VSP calculated quantity of samples: Δ = 50% of benchmark <sup>2</sup>			
AOC-1: Surface Soil											
1,2,4-Trimethylbenzene	41	52.1450076	0.0032	9.38E-04	9.38E-04	0.001	2	2	yes	None	
Acetone	41	5417.410632	0.0963	8.19E-03	8.19E-03	0.015	2	2	yes	None	
Aluminum	41	6521.159099	25400	5.73E+03	5.73E+03	5176.137	365	23	no	None	
Arsenic	41	0.389623911	3.1	1.25E+00	1.25E+00	0.899	11	184	no	None	
Barium	41	7840.506738	1250	1.28E+02	1.28E+02	234.679	2	2	yes	None	
Benzo(a)anthracene	41	0.147618746	3.97	2.45E-01	2.45E-01	0.686	429	741	no	14	1
Benzo(a)pyrene	41	0.014761875	0.775	1.12E-01	1.12E-01	0.180	31	5087	yes	None	
Benzo(b)fluoranthene	41	0.147618746	1.03	0.134817073	1.35E-01	0.200	2088	65	no	14	1
Beryllium	41	37.56447258	0.89	1.98E-01	1.98E-01	0.180	2	2	yes	None	
bis(2-Ethylhexyl)phthalate	39	34.74146517	0.55	1.43E-01	1.43E-01	0.171	2	2	yes	None	
Cadmium	41	38.98499196	1.1	1.06E-01	1.06E-01	0.181	2	2	yes	None	
Chromium	41	210.6754386	14.9	4.98E+00	4.98E+00	3.527	2	2	yes	None	
Chromium - Hexavalent	41	30.09649123	3.1	7.99E-01	7.99E-01	0.499	2	2	yes	None	
Chrysene	41	14.7618746	41.2	1.33E+00	1.33E+00	6.554	4	9	yes	None	
Cobalt	41	902.8947368	4.6	1.29E+00	1.29E+00	0.999	2	2	yes	None	
Copper	41	547.5959196	23.5	4.11E+00	4.11E+00	4.008	2	2	yes	None	
Isopropylbenzene	41	370.8389082	0.02265	1.57E-03	1.57E-03	0.004	2	2	yes	None	
Lead	41	400	80.7	1.43E+01	1.43E+01	17.890	2	2	yes	None	
Manganese	41	3239.292441	210	7.85E+01	7.85E+01	55.777	2	2	yes	None	
Mercury	41	2.087229064	0.74	3.15E-02	3.15E-02	0.114	2	2	yes	None	
Methylene chloride	41	1.261141011	0.0235	4.31E-03	4.31E-03	0.005	2	2	yes	None	
Nickel	41	832.1043138	9.3	2.54E+00	2.54E+00	2.087	2	2	yes	None	
Phenanthrene	41	1705.202797	2.06	1.56E-01	1.56E-01	0.341	2	2	yes	None	
Pyrene	41	1697.614513	1.58	1.73E-01	1.73E-01	0.281	2	2	yes	None	
Toluene	41	521.1703381	0.0044	9.74E-04	9.74E-04	0.001	2	2	yes	None	
Vanadium	41	291.0143463	29.3	7.64E+00	7.64E+00	6.379	2	2	yes	None	
Xylene (total)	41	214.4802501	0.0077	2.89E-03	2.89E-03	0.001	2	2	yes	None	
Zinc	41	9921.473875	232	4.66E+01	4.66E+01	46.576	2	2	yes	None	
AOC-1:Surface Soil number of additional samples needed for Human Health Risk Evaluation										14	

AOC-1: Subsurface Soil											
1,2,4-Trimethylbenzene	41	52.1450076	0.14	0.006079268	6.08E-03	0.02472345	2	2	yes	None	
Acetone	41	5417.410632	0.249	0.027578049	2.76E-02	0.04119946	2	2	yes	None	
Aluminum	41	6521.159099	13800	3553.829268	3.55E+03	3361.658816	13	11	yes	None	
Arsenic	41	0.389623911	2.2	0.635853659	6.36E-01	0.583684314	50	79	no	9	2
Barium	41	7840.506738	98.7	30.54512195	3.05E+01	25.31918691	2	2	yes	None	
Beryllium	41	37.56447258	0.42	0.114085366	1.14E-01	0.102359715	2	2	yes	None	
Carbon disulfide	41	721.25424	0.0041	0.001006098	1.01E-03	0.000685674	2	2	yes	None	
Chromium	41	210.6754386	15	3.088780488	3.09E+00	2.694931534	2	2	yes	None	
Chromium, Hexavalent	41	30.09649123	1.6	0.676829268	6.77E-01	0.24852001	2	2	yes	None	
Cobalt	41	902.8947368	1.9	0.55902439	5.59E-01	0.499144543	2	2	yes	None	
Copper	41	547.5959196	5.9	1.484512195	1.48E+00	1.26380962	2	2	yes	None	
Diethyl phthalate	41	1424.363096	0.31	0.045792683	4.58E-02	0.05078914	2	2	yes	None	
Lead	41	400	26	3.752439024	3.75E+00	3.956007318	2	2	yes	None	
Manganese	41	3239.292441	241	42.83292683	4.28E+01	53.72204111	2	2	yes	None	
Mercury	41	2.087229064	0.59	0.024779756	2.48E-02	0.091786819	2	2	yes	None	
Methylene chloride	41	1.261141011	0.0999	0.007378049	7.38E-03	0.015947218	2	2	yes	None	
Nickel	41	832.1043138	5.9	1.334756098	1.33E+00	1.420189226	2	2	yes	None	
Vanadium	41	291.0143463	13.7	3.956341463	3.96E+00	3.396336818	2	2	yes	None	
Xylene (total)	41	214.4802501	0.0217	0.003138415	3.14E-03	0.003424042	2	2	yes	None	
Zinc	41	9921.473875	24.8	7.409756098	7.41E+00	5.986727189	2	2	yes	None	
AOC-1:Subsurface Soil number of additional samples needed for Human Health Risk Evaluation										9	
Total AOC-1: Soil number of additional samples needed for Human Health Risk Evaluation										14	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] probabilities are 20% to 95% [of threshold], i.e. from beta to 1-alpha ... Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation. "

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - Two methods are used to calculate sample size: method 1 is preferred because it provides the samples needed to determine a difference between the sample mean and the threshold. Sometimes the mean is very close to the threshold and the standard deviation is large so method 1 returns unreasonable sizes. When this occurs, method 2 results are examined as a backup. Method 2 provides the samples needed to detect a difference within 50% of the benchmark. The VSP recommended sample size is used or professional judgement (see notes next column). When sampling is conducted for that chemical, other analyses will be run.

Notes:

detected (12.8%). Concentrations of benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene are found in the same vicinity, as follows: J-03S, J-04S, J-09S, J-12S, and J-14S. Because the concentrations are found together, a judgement was made to collect 14 samples for benzo(a)anthracene based on the sample size needed for benzo(b)fluoranthene.

2. Arsenic: the sample size equation indicates nine samples are recommended (50-41=9). Arsenic is a naturally occurring metal and may not be different from background.

Table D-2  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for  
Ecological Risk Evaluation

[illegible]

AOC-1: Subsurface Soil											
Arsenic	41	0.389623911	2.2	0.635853659	6.36E-01	0.583684314	2	79	yes	None	
Barium	41	7840.506738	98.7	30.54512195	3.05E+01	25.31918691	2	2	yes	None	
Beryllium	41	37.56447258	0.42	0.114085366	1.14E-01	0.102359715	2	2	yes	None	
Chromium	41	210.6754386	15	3.088780488	3.09E+00	2.694931534	10	2	yes	None	
Cobalt	41	902.8947368	1.9	0.55902439	5.59E-01	0.499144543	2	2	yes	None	
Copper	41	547.5959196	5.9	1.484512195	1.48E+00	1.26380962	2	2	yes	None	
Diethyl phthalate	41	1424.363096	0.31	0.045792683	4.58E-02	0.05078914	2	2	yes	None	
Lead	41	400	26	3.752439024	3.75E+00	3.956007318	2	2	yes	None	
Manganese	41	3239.292441	241	42.83292683	4.28E+01	53.72204111	2	2	yes	None	
Mercury	41	2.087229064	0.59	0.024779756	2.48E-02	0.091786819	15	2	yes	None	
Nickel	41	832.1043138	5.9	1.334756098	1.33E+00	1.420189226	2	2	yes	None	
Vanadium	41	291.0143463	13.7	3.956341463	3.96E+00	3.396336818	28	2	yes	None	
Zinc	41	9921.473875	24.8	7.409756098	7.41E+00	5.986727189	2	2	yes	None	
AOC-1:Subsurface Soil number of additional samples needed for Human Health Risk Evaluation										0	
Total AOC-1: Soil number of additional samples needed for Human Health Risk Evaluation										0	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

2 - D = 50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] probabilities are 20% to 95% [of threshold], i.e. from beta to 1-alpha ... Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation. "

3 - Statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples. In this case we are focusing on the number of samples

4 - Two methods are used to calculate sample size: method 1 is preferred because it provides the samples needed to determine a difference between the sample mean and the threshold. Sometimes the mean is very close to the threshold and the standard deviation is large so method 1 returns unreasonable sizes. When this occurs, method 2 results are examined as a backup. Method 2 provides the samples needed to detect a difference within 50% of the benchmark - the VSP recommended sample size is used or professional judgment (see notes next column) when sampling is conducted for that chemical. Other analyses will be run.

Notes:

of 29.3 mg/kg and 6.64 mg/kg, respectively, additional samples would not likely change the outcome. There is one statistical outlier and data are highly skewed as the median is 5.25 mg/kg, quite a bit lower than the mean. For this reason and the fact that Vanadium is a naturally occurring metal and may not be different from background, additional samples are not warranted.

Table D-3  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for  
Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/l)					Sample Size Method 1	Sample Size Method 2	Statistical Power? <sup>3</sup>	Proposed quantity of additional samples to collect <sup>4</sup>	Notes
		Bench- mark	Max	Mean	95th UCL of Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark <sup>1</sup>	VSP calculated quantity of samples: Δ = 50% of benchmark <sup>2</sup>			
AOC-1: Ground Water- Human Health											
1-Methylnaphthalene	20	1.7109375	0.0647	0.0053375	5.34E-03	0.01449323	2	2	yes	None	
Acetone	20	5.475	0.0089	0.004945	4.95E-03	0.00226616	2	2	yes	None	
Aluminum	20	2.444196429	4.28	0.503205	5.03E-01	0.97617262	4	7	yes	None	
Arsenic	20	0.01	0.0437	0.0084375	8.44E-03	0.01033647	377	38	no	7	1
Barium	20	2	0.557	0.1824725	1.82E-01	0.13972086	2	2	yes	None	
Benzene	20	0.005	0.0145	0.00112275	1.12E-03	0.00321632	8	16	yes	None	
bis(2-Ethylhexyl)phthalate	20	0.004802252	0.00663	0.00126875	1.27E-03	0.00135615	3	5	yes	None	
Cyclohexane	20	12.51428571	0.0323	0.001928	1.93E-03	0.00715044	2	2	yes	None	
Ethylbenzene	20	0.7	0.008	0.00106075	1.06E-03	0.00195502	2	2	yes	None	
Lead	20	0.015	0.0195	0.003755	3.76E-03	0.0046173	3	5	yes	None	
Manganese	20	1.148772321	4.12	0.81615	8.16E-01	0.98445534	77	27	no	7	2
Naphthalene	20	0.006202941	0.163	0.0117275	1.17E-02	0.03646188	375	1185	no	7	3
Nickel	20	0.488839286	0.0516	0.0052025	5.20E-03	0.01117783	2	2	yes	None	
Thallium	20	0.002	0.0067	0.00340875	3.41E-03	0.00181263	16	30	yes	None	
Vanadium	20	0.17109375	0.01665	0.002706	2.71E-03	0.00434736	2	2	yes	None	
Zinc	20	7.332589286	0.196	0.03199	3.20E-02	0.04151148	2	2	yes	None	
AOC-1:Ground water number of additional samples needed for Human Health Risk Evaluation										7	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] probabilities are 20% to 95% [of threshold], i.e. from beta to 1-alpha ... Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation. "

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

hypothesis test rejects the null hypothesis that Arsenic is greater than the benchmark and Arsenic is a naturally occurring metal and may not be different from background. For these reasons judgement is used to propose additional samples. The additional samples proposed are 7, as indicated by VSP for Manganese.

rejects the null hypothesis that Manganese is greater than the benchmark and Manganese is a naturally occurring metal and may not be different from background. For these reasons the Method 2 sample size is proposed (27-20=7).

nonparametric hypothesis test rejects the null hypothesis that Naphthalene is greater than the benchmark. For these reasons judgement is used to propose additional samples. The additional samples proposed are 7, as indicated by VSP for Manganese.

Table D-4  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)					Sample Size Method 1	Sample Size Method 2	Statistical Power? <sup>3</sup>	Proposed quantity of additional samples to collect <sup>4</sup>	Notes
		Bench- mark	Max	Mean	95th UCL of Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark <sup>1</sup>	VSP calculated quantity of samples: Δ = 50% of benchmark <sup>2</sup>			
AOC-3: Surface Soil											
Aluminum	7	6521.159099	6015	4.03E+03	4.03E+03	1307.290	4	3	yes	None	
Arsenic	7	0.389623911	1307.289544	1.18E+00	1.18E+00	0.594	7	82	yes	None	
Barium	7	7840.506738	630	1.90E+02	1.90E+02	209.832	2	2	yes	None	
Beryllium	7	37.56447258	0.24	1.79E-01	1.79E-01	0.057	2	2	yes	None	
Chromium	7	210.6754386	5.9	4.04E+00	4.04E+00	1.439	2	2	yes	None	
Cobalt	7	902.8947368	1.35	9.80E-01	9.80E-01	0.314	2	2	yes	None	
Copper	7	547.5959196	4.6	3.56E+00	3.56E+00	0.806	2	2	yes	None	
Lead	7	400	13.5	6.671428571	6.67E+00	3.391	2	2	yes	None	
Manganese	7	3239.292441	226	1.07E+02	1.07E+02	55.617	2	2	yes	None	
Mercury	7	2.087229064	0.022	1.19E-02	1.19E-02	0.006	2	2	yes	None	
Nickel	7	832.1043138	2.5	1.83E+00	1.83E+00	0.607	2	2	yes	None	
Vanadium	7	291.0143463	8.4	5.93E+00	5.93E+00	1.761	2	2	yes	None	
Zinc	7	9921.473875	346	1.18E+02	1.18E+02	135.018	2	2	yes	None	
AOC-3:Surface Soil number of additional samples needed for Human Health Risk Evaluation										0	



AOC-3: Subsurface Soil											
Acetone	7	5417.410632	0.0804	0.028671429	2.87E-02	0.024401483	2	2	yes	None	
Aluminum	7	6521.159099	4600	3628.571429	3.63E+03	776.7330852	2	2	yes	None	
Arsenic	7	0.389623911	2.4	1.12	1.12E+00	0.640650711	8	9	no	1	1
Barium	7	7840.506738	209	55.18571429	5.52E+01	68.79468072	2	2	yes	None	
Beryllium	7	37.56447258	0.2	0.161142857	1.61E-01	0.038589414	2	2	yes	None	
Chromium	7	210.6754386	4	3.285714286	3.29E+00	0.649175301	2	2	yes	None	
Cobalt	7	902.8947368	1.1	0.845714286	8.46E-01	0.200321171	2	2	yes	None	
Copper	7	547.5959196	5	2.442857143	2.44E+00	1.195626952	2	2	yes	None	
Lead	7	400	4.3	2.985714286	2.99E+00	0.638823323	2	2	yes	None	
Manganese	7	3239.292441	114	72.75714286	7.28E+01	36.2172545	2	2	yes	None	
Mercury	7	2.087229064	0.034	0.013671429	1.37E-02	0.013946292	2	2	yes	None	
Nickel	7	832.1043138	2.3	1.628571429	1.63E+00	0.4029652	2	2	yes	None	
Toluene	7	521.1703381	0.0018	0.001292857	1.29E-03	0.000511068	2	2	yes	None	
Vanadium	7	291.0143463	7.9	5.328571429	5.33E+00	1.209289441	2	2	yes	None	
Zinc	7	9921.473875	35.8	16.6	1.66E+01	9.153869856	2	2	yes	None	
AOC-3:Subsurface Soil number of additional samples needed for Human Health Risk Evaluation										1	
Total AOC-3: Soil number of additional samples needed for Human Health Risk Evaluation										1	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] probabilities are 20% to 95% [of threshold], i.e. from beta to 1-alpha ... Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation."

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

**Notes:**

1. **Arsenic:** VSP recommends one additional sample to detect a difference between the mean of the site and background in the subsurface soil (8-7=1). Arsenic is a naturally occurring metal and may not be different from background.



Table D-5  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for  
Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)					Sample Size Method 1	Sample Size Method 2	Statistical Power? <sup>3</sup>	Proposed quantity of additional samples to collect <sup>4</sup>	Notes
		Bench- mark	Max	Mean	95th UCL of Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark <sup>1</sup>	VSP calculated quantity of samples: Δ = 50% of benchmark <sup>2</sup>			
AOC-3: Surface Soil											
Arsenic	7	18	1307.289544	1.18E+00	1.18E+00	0.594	2	2	yes	None	
Barium	7	330	630	1.90E+02	1.90E+02	209.832	21	16	no	14	1
Beryllium	7	10	0.24	1.79E-01	1.79E-01	0.057	2	2	yes	None	
Chromium	7	0.4	5.9	4.04E+00	4.04E+00	1.439	3	445	yes	None	
Cobalt	7	13	1.35	9.80E-01	9.80E-01	0.314	2	2	yes	None	
Copper	7	61	4.6	3.56E+00	3.56E+00	0.806	2	2	yes	None	
Lead	7	120	13.5	6.671428571	6.67E+00	3.391	2	2	yes	None	
Manganese	7	500	226	1.07E+02	1.07E+02	55.617	2	2	yes	None	
Mercury	7	0.1	0.022	1.19E-02	1.19E-02	0.006	2	2	yes	None	
Nickel	7	30	2.5	1.83E+00	1.83E+00	0.607	2	2	yes	None	
Vanadium	7	2	8.4	5.93E+00	5.93E+00	1.761	4	28	yes	None	
Zinc	7	120	346	1.18E+02	1.18E+02	135.018	34926	45	no	14	2
AOC-3:Surface Soil number of additional samples needed for Ecological Risk Evaluation											14

AOC-3: Subsurface Soil											
Arsenic	7	18	2.4	1.12	1.12E+00	0.640650711	2	2	yes	None	
Barium	7	330	209	55.18571429	5.52E+01	68.79468072	2	3	yes	None	
Beryllium	7	10	0.2	0.161142857	1.61E-01	0.038589414	2	2	yes	None	
Chromium	7	0.4	4	3.285714286	3.29E+00	0.649175301	2	92	yes	None	
Cobalt	7	13	1.1	0.845714286	8.46E-01	0.200321171	2	2	yes	None	
Copper	7	61	5	2.442857143	2.44E+00	1.195626952	2	2	yes	None	
Lead	7	120	4.3	2.985714286	2.99E+00	0.638823323	2	2	yes	None	
Manganese	7	500	114	72.75714286	7.28E+01	36.2172545	2	2	yes	None	
Mercury	7	0.1	0.034	0.013671429	1.37E-02	0.013946292	2	3	yes	None	
Nickel	7	30	2.3	1.628571429	1.63E+00	0.4029652	2	2	yes	None	
Toluene	7	200	0.0018	0.001292857	1.29E-03	0.000511068	2	2	yes	None	
Vanadium	7	2	7.9	5.328571429	5.33E+00	1.209289441	3	14	yes	None	
Zinc	7	120	35.8	16.6	1.66E+01	9.153869856	2	2	yes	None	
AOC-3:Subsurface Soil number of additional samples needed for Ecological Risk Evaluation										0	
Total AOC-3: Soil number of additional samples needed for Ecological Risk Evaluation										14	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] probabilities are 20% to 95% [of threshold], i.e. from beta to 1-alpha ... Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation. "

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. Barium. VSP recommends 14 additional sample to detect a difference between the mean of the site and background in the subsurface soil (21-7=14). Barium is a naturally occurring metal and may not be different from background. samples would not likely change the outcome. For this reason and the fact that Zinc is a naturally occurring metal and may not be different from background, additional samples equal to those recommended for Barium are proposed.

Table D-6  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health and Ecological Risk Evaluation

Constituent	Quantity of Phase I samples		Concentration (mg/l)				Sample Size Method 1	Sample Size Method 2	Statistical Power? <sup>3</sup>	Proposed quantity of additional samples to collect <sup>4</sup>	Notes
		Bench- mark	Max	Mean	95th UCL of Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark <sup>1</sup>	VSP calculated quantity of samples: Δ = 50% of benchmark <sup>2</sup>			
AOC-3: Surface Water- Human Health											
Antimony	7	0.64	0.0042	0.002960714	2.96E-03	0.001245313	2	2	yes	None	
Chromium - Hexavalent	7	2.216	0.016	0.006857143	6.86E-03	0.00612178	2	2	yes	None	
Lead	7	0.0169	0.0102	0.004464286	4.46E-03	0.002868901	2	2	yes	None	
Manganese	7	0.1	0.194	0.058542857	5.85E-02	0.078974634	33	23	no	16	1
Zinc	7	26	0.0758	0.029771429	2.98E-02	0.020735293	2	2	yes	None	
AOC-3:Surface water number of additional samples needed for Human Health Risk Evaluation										16	
AOC-3: Surface Water- Ecological											
Barium	7	25	0.768	0.477228571	4.77E-01	0.243435239	2	2	yes	None	
Chromium - Hexavalent	7	0.0496	0.016	0.006857143	6.86E-03	0.00612178	2	2	yes	None	
Lead	7	0.0053	0.0102	0.004464286	4.46E-03	0.002868901	103	12	no	5	2
Zinc	7	0.0842	0.0758	0.029771429	2.98E-02	0.020735293	3	4	yes	None	
AOC-3:Surface water number of additional samples needed for Ecological Risk Evaluation										5	
Total AOC-3: Surface water of additional samples needed for Human Health and Ecological Risk Evaluation										16	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] probabilities are 20% to 95% [of threshold], i.e. from beta to 1-alpha ... Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation. "

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:  
1. Manganese: the Method 1 sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark. For this reason and the fact that manganese is a naturally occurring metal and may not be different from background, the Method 2 sample size is proposed (23-7=16).  
2. Lead: the Method 1 sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark. For this reason and the fact that Lead is a naturally occurring metal and may not be different from background, the Method 2 sample size is proposed (12-7=5).

Table D-7  
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health and Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)					Sample Size Method 1	Sample Size Method 2	Statistical Power? <sup>3</sup>	Proposed quantity of additional samples to collect <sup>4</sup>	Notes
		Bench- mark	Max	Mean	95th UCL of Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark <sup>1</sup>	VSP calculated quantity of samples: Δ = 50% of benchmark <sup>2</sup>			
<b>AOC-3: Sediment- Human Health</b>											
1,2,4-Trimethylbenzene	44	37000	0.0049	0.001032386	1.03E-03	0.000903411	2	2	yes	None	
Acetone	44	660000	0.668	0.05605	5.61E-02	0.107525611	2	2	yes	None	
Aluminum	44	150000	35900	6668.954545	6.67E+03	8084.757611	2	2	yes	None	
Arsenic	44	110	17.3	2.530681818	2.53E+00	2.988662023	2	2	yes	None	
Barium	44	23000	1695	189.4295455	1.89E+02	302.7681716	2	2	yes	None	
Beryllium	44	27	1.4	0.272477273	2.72E-01	0.307157579	2	2	yes	None	
bis(2-Ethylhexyl)phthalate	44	240	0.729	0.103099432	1.03E-01	0.13282601	2	2	yes	None	
Cadmium	44	1100	0.67	0.120340909	1.20E-01	0.133983285	2	2	yes	None	
Carbon disulfide	44	73000	0.0241	0.002526705	2.53E-03	0.004430944	2	2	yes	None	
Chromium	44	36000	29.9	6.347727273	6.35E+00	7.124131563	2	2	yes	None	
Cobalt	44	32000	10.4	1.756761364	1.76E+00	2.154330251	2	2	yes	None	
Copper	44	21000	57.1	7.546590909	7.55E+00	10.80206913	2	2	yes	None	
Hexane	44	44000	0.0086	0.001347159	1.35E-03	0.00153868	2	2	yes	None	
Lead	44	500	34.1	8.564772727	8.56E+00	7.705635053	2	2	yes	None	
Manganese	44	14000	588	142.0795455	1.42E+02	146.8601733	2	2	yes	None	
Mercury	44	34	0.11	0.015535682	1.55E-02	0.018274086	2	2	yes	None	
Methyl ethyl ketone	44	440000	0.135	0.011036364	1.10E-02	0.020764445	2	2	yes	None	
Methylene chloride	44	7300	0.0199	0.005052841	5.05E-03	0.00286889	2	2	yes	None	
Nickel	44	1400	23.5	3.906363636	3.91E+00	4.871045846	2	2	yes	None	
Selenium	44	2700	2.2	0.294602273	2.95E-01	0.384344785	2	2	yes	None	
Silver	44	350	1.3	0.131102273	1.31E-01	0.246448585	2	2	yes	None	
Toluene	44	59000	0.0376	0.002010227	2.01E-03	0.005574465	2	2	yes	None	
Vanadium	44	330	58.9	10.24772727	1.02E+01	12.2786161	2	2	yes	None	
Zinc	44	76000	896	1.69E+02	1.69E+02	227.274	2	2	yes	None	
<b>AOC-3:Sediment number of additional samples needed for Human Health Risk Evaluation</b>										0	

AOC-3: Sediment- Ecological											
Arsenic	44	8.2	17.3	2.530681818	2.53E+00	2.988662023	4	6	yes	None	
bis(2-Ethylhexyl)phthalate	44	0.182	0.729	0.103099432	1.03E-01	0.13282601	26	20	yes	None	
Cadmium	44	1.2	0.67	0.120340909	1.20E-01	0.133983285	2	2	yes	None	
Chromium	44	81	29.9	6.347727273	6.35E+00	7.124131563	2	2	yes	None	
Copper	44	34	57.1	7.546590909	7.55E+00	10.80206913	3	5	yes	None	
Lead	44	46.7	34.1	8.564772727	8.56E+00	7.705635053	2	3	yes	None	
Mercury	44	0.15	0.11	0.015535682	1.55E-02	0.018274086	2	2	yes	None	
Methylene chloride	44	3.82	0.0199	0.005052841	5.05E-03	0.00286889	2	2	yes	None	
Nickel	44	20.9	23.5	3.906363636	3.91E+00	4.871045846	3	4	yes	None	
Silver	44	1	1.3	0.131102273	1.31E-01	0.246448585	3	4	yes	None	
Toluene	44	0.94	0.0376	0.002010227	2.01E-03	0.005574465	2	2	yes	None	
Zinc	44	150	896	1.69E+02	1.69E+02	227.274	1262	80	no	None	1
AOC-3:Sediment number of additional samples needed for Ecological Risk Evaluation										0	
Total AOC-3: Sediment number of additional samples needed for Human Health and Ecological Risk Evaluation										0	

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4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

the null hypothesis that the site is dirty could be rejected using the nonparametric test (see VSP output), additional samples would not likely change the outcome. For this reason and the fact that Zinc is a naturally occurring metal and may not be different from background, additional samples are not proposed.